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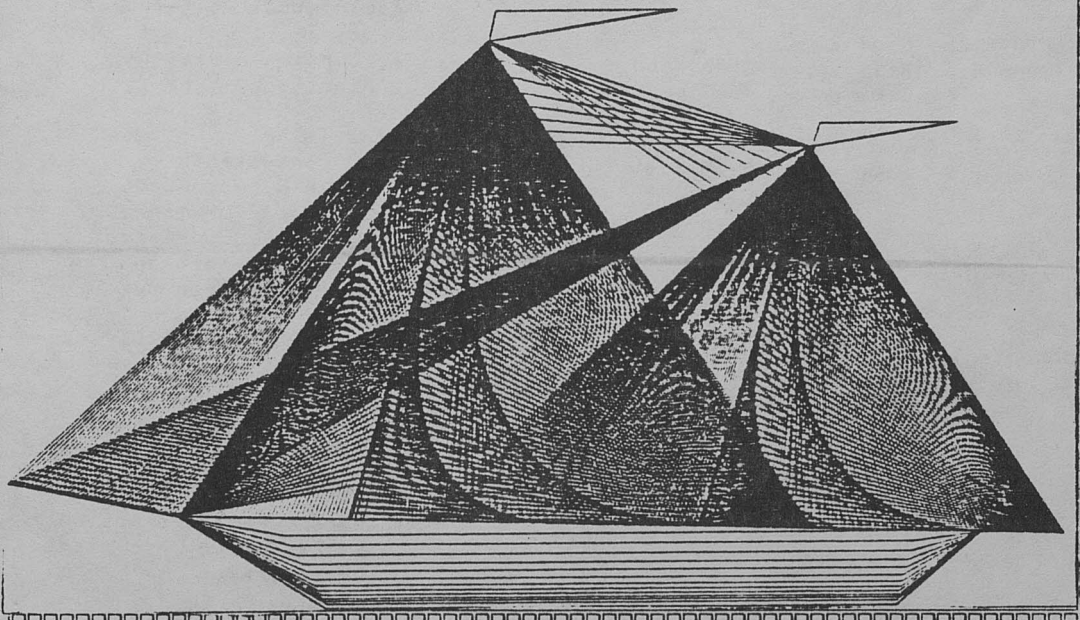
Computing at Lehigh

Lehigh University's
Computing Center Newsletter

Volume XIV, No. 1

September 1986



A Packet Ship

CalComp Graphics

Lehigh University Computing Center Hardware

CDC CYBER 180 Model 850 (4 MWords Memory, NOS V2.4.3 & NOS/VE V1.1.4)
DECSYSTEM-20 Model 2065 (2 MWords Memory, TOPS-20 V5(46)-3)
IBM 4381 Model 2 (4 MWords Memory, VM/SP V1.4, MUSIC/SP V1.1)
IBM 4361 Model 5 (1 MWord Memory, VSE/SP V2.1.3)
Zenith Z-100 PC Series (256-512 KBytes Memory, MS-DOS V2.11 & V3.10)

Hours of Operation

Academic Schedule

Users' Area, Room 180

Sun	2:00 pm - 10:00 pm
Mon-Thu	6:30 am - 12:00 midn
Fri	6:30 am - 10:00 pm
Sat	9:00 am - 5:00 pm

Consulting Window, Room 181

Sun	2:00 pm - 10:00 pm
Mon-Thu	8:00 am - 12:00 midn
Fri	8:00 am - 5:00 pm
Sat	10:00 am - 5:00 pm

Business Office, Room 396

Mon-Fri	8:15 am - 12:00 noon
	1:00 pm - 4:45 pm

User Services, Rooms 194/196

Mon-Fri	8:00 am - 12:00 noon
	1:00 pm - 5:00 pm

Operations, Room 171

Mon-Fri	8:00 am - 11:30 am
	1:00 pm - 4:30 pm

Microcomputer Store, Sayre Bldg.

Mon-Wed	9:00 am - 5:00 pm
Thu	9:00 am - 7:00 pm
Fri	9:00 am - 5:00 pm

Special Forms - CYBER 850

Liquid Ink Plots

Tue,Fri	8:00 am - until done

Special Forms - DEC-20

/Forms:Unline

Sun-Sat	2:00 pm - until done

/Forms:Laser

Sun-Sat	11:00 am - 1:00 pm (Except Sun.)
	6:00 pm - 8:00 pm (Except Sat.)

Consulting Policy

Consultants are provided for assisting users in the use of Lehigh University's computer resources. Consultants are not authorized to assist with interpreting course assignments, to write code, or to debug program logic.

When in need of a consultation, users are requested to first contact the LUCC student consultants (present at many of the public sites and at ext. 84141), who are hired to augment the full-time staff consultants.

Computing Center Directory

Information About Policies and Plans

Director		
William R. Harris	(215)	758-3830
User Services Manager		
Timothy J. Foley		758-3990
Operations Manager		
Carol D. Rauch		758-3989
Microcomputer Store Manager		
Robert R. Kendi		758-4606
Systems Programming Manager		
Kevin R. Weiner		758-3991

Information About Bills Received

Administrative Associate	
Joseph P. Holzer	758-3825
Accounting Assistant	
Annette L. Ruhe	758-3825

Consulting

User Consultants	
Blair R. Bernhardt	758-3994
Monica A. Newman	758-3995
George E. Oberlander	758-3218
Joel W. Robertson	758-3985
Kenneth R. van Wyk	758-4998

Information About Software Availability

Software Librarian	
Judy K. Allio	758-3993

Systems Status, Technical Information

On-duty Consultant	758-4141

General User Information

Data Processing Assistant	
Doris Oravec	758-3990

Accounts Coordinator

Florence G. Hughes	758-3992

Information About Tapes and Supplies

D. P. Tape Librarian	
Monica M. Herrera	758-4140

On-Campus Computer Access

CYBER 850	(300/1200 Baud)	Ext. 46812
	(9600 Baud)	Ext. 46800
DEC-20	(All Baud Rates)	Ext. 46200

Off-Campus Computer Access

CYBER 850	(300/1200 Baud)	974-6812
DEC-20	(300/1200 Baud)	974-6200

Computing at Lehigh

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Volume XIV, No. 1
September 1986

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Computing at Lehigh is a bi-monthly report on computing published by the Lehigh University Computing Center. Article contributions are primarily by Computing Center staff, although articles by users may also be included at the discretion of the Computing Center. Instructions for submitting articles can be found in the Computing at Lehigh Contribution Information included at the end of this newsletter.

Computing at Lehigh is distributed free of charge to the Lehigh University Computing Center user community and other interested parties. If you wish to be placed on, removed from, or have your address changed on the mailing list, please return the Computing at Lehigh Mailing List form included at the end of this newsletter.

Computing at Lehigh is produced on a DEC-20 using Scribe and printed on a Talaris 1200 laser printer.

From the Editor

by George E. Oberlander

Things at LUCC are definitely *busy.* Intense effort is being put into activities related to the InteCom installation — checking and enhancing the network's data communications capabilities, improving and expanding user interfaces, etc. Our current issue reflects this dynamic state: we have articles and notices about using the InteCom system, facilities and equipment changes, new programs (mainframe and micro), and more. We even had to change the "boilerplate" on page 1 to reflect the new telephone numbers for staff as well as for the mainframes.

In his article, Bill Harris — LUCC's new Director — lists the goals for the coming year. LUCC is working actively toward many of these goals, while progress toward other goals awaits the necessary funds and personnel.

There have been a few important mainframe equipment changes which Carol Rauch, Manager of Operations, has described in her article "Peripheral Equipment Changes."

TWODEPEP and *TEMPLATE* users should read Judy Allio's contribution on CYBER 850 software changes.

Microcomputing software changes include a new *WATFOR-77* FORTRAN development system, complete with a graphics facility. This will be the compiler of choice for Engineering I students and for others who want the convenience of a micro-based FORTRAN system which adheres to the FORTRAN-77 standard (with carefully documented extensions). See Monica Newman's article on *WATFOR-77* for more information.

Use of the InteCom system to establish a connection with the CYBER 850 and the DEC-20 is documented in Monica's article *Mainframe Connections Using InteCom.*

EDUNET users take note: applications for funds to use this facility are being accepted again. See the "Newsbriefs" section for more information.

There's also a continuation of the local area networking series written by this editor. Topologies, access methods, the OSI and IEEE networking models and other things are treated there.

Good reading!

Feedback

Do you have a suggestion, a complaint, or comment about something in our newsletter? If so, why not let us know so we can include it in Feedback*? See the Computing at Lehigh Contribution Information at the end of this newsletter for details on how to submit letters to* Feedback.

From the Director

by William R. Harris

As we begin a new academic year, I am sure that many of you have noted the rapidly changing computing environment at Lehigh. I have reviewed the LUCC annual report, written by Gary Lutz, in which he reported on accomplishments with regard to the previous year's plans. That list of objectives, containing two dozen items, is too long to discuss in any detail in this article. I will rely on *Computing at Lehigh* to inform you of the expanded services and changes.

What I feel is more important is to outline the goals of the coming year and solicit your comments. Please feel free to contact me regarding any of the following goals and challenges to both LUCC and you. As the year progresses, I will be discussing our progress with regard to this list.

1. Participate in the implementation of the InteCom digital PBX, particularly regarding the connection of LUCC mainframes and public workstations to that network.

2. Implement the Network Services System, to provide services such as electronic mail, remote file storage, print queuing, etc.

3. Develop software to facilitate network usage, e.g., a menu-driven system which would allow a user to easily select the resource to which he or she wishes to be connected.

4. Specify, propose, budget for, select and implement a high volume, publication quality printing service (laser printer) to be installed as a network resource.

5. Provide training in printed, seminar, and on-line form regarding network usage.

6. Specify, select, and implement local area networks at the LUCC public sites, to facilitate the management and distribution of software.

7. Continue operation of the Microcomputer Store, placing an emphasis on alumni and student sales and on improved maintenance services.

8. Establish microcomputer classrooms of the type recommended in the report of the Ad Hoc Committee on University Computing. Note, however, that space and funds for both equipment and renovations have yet to be established.

9. Continue to enhance and expand the graphics services offered by LUCC.

10. Provide training in the use of NOS/VE, the virtual memory operating system for the CYBER 850.

11. Continue to provide support for users needing access to supercomputer facilities, and expand LUCC's command of the technology in order to provide guidance for the University as it considers its supercomputing alternatives.

12. Finalize the phase-out plan for the DEC-2065, and investigate a replacement should it be deemed necessary.

13. Continue to address the expansion of the mainframe software library, and to pursue the negotiation of site licenses and significant discounts for microcomputer software.

14. Continue to manage the CYBER 810 for the CCPMC, and more formally identify the facilities management issues for future similar arrangements.

15. Expand the training services provided by LUCC, giving particular attention to the production of video media.

16. Continue to investigate the opportunities available in such areas as the provision of a more transparent computing environment and the sharing of peripheral equipment among mainframes.

17. Complete the implementation of LUCC's on-line library and documentation system.

18. Investigate and implement high-speed host-to-host data connections, to facilitate shared processing between the CYBER 850 and other mainframe machines on campus.

19. Provide UNIX support on the CYBER 850.

20. Expand LUCC's knowledge and implementation of AI languages and systems, expert systems, and natural language systems.

21. Identify and provide additional training for faculty to incorporate microcomputers and networking into their teaching and research.

22. Establish a plan for phasing out public site dumb terminals.

23. Investigate the use of optical disk technology for the storage and retrieval of information.

24. Examine the internal organization of LUCC, and recommend changes where necessary in light of the many new roles that have emerged for the Center.

25. Continue to address the staffing issues which must necessarily accompany the above issues. This continues to be LUCC's highest priority if we are to accomplish all of these objectives, many of which are the consequences of actions taken outside of the Computing Center.

Mainframe Computing

Peripheral Equipment Changes

by Carol Rauch

This article discusses recent and planned changes to peripheral equipment and their effect on related services.

Card Reader

The CYBER 850 no longer has a card reader, and the last keypunch machine has been removed from the users' area. Those of you who still may not have completed your card conversion should know that LUCC now has a card reader (a Peripheral Dynamics, Inc., Model 2022) which is connected to a Zenith microcomputer. This setup allows the contents of cards to be written to a diskette, from which the information can be transferred to a mainframe for further processing. The reader can be found in the Special Equipment Room, which is adjacent to the Consultant's Area at the central site. Please note that object (binary) decks are *not* supported by this new system.

LUCC has written an interface program, *CARD.COM*, for use with this device. This program resides on floppy disk and can be obtained from the consultant on duty, as can *Technical Bulletin #5 - Using the PDI Card Reader.* Estimated throughput for the system is about 225 cards per minute, although rates will vary depending upon the amount of data on the cards and whether the card reader must be taken off-line to refill the card hopper.

Cyber Printer

One of the Cyber's two high-speed central site printers has been removed from service, as CDC has discontinued maintenance support for that model. A goal of the Computing Center is to permit mainframes to share printers; however, until another printer is available to the CYBER, CYBER users may experience some delays in obtaining printed output, particularly when a job in the long print queue (> 200 pages) is being printed.

Magnetic Tape Drives

For the past several years, the Computing Center has been converting to magnetic tape drives which support 9-track format at 1600/6250 bits per inch (bpi) densities. All host mainframes now have the ability to read/write such tapes. *The CYBER 850's last 800/1600 bpi tape drive is scheduled to be removed from service on December 30, 1986.* Users who still have 800 bpi tapes *must convert them by this date* or the tapes will become unreadable at LUCC.

DEC-20 Laser Printer

Since its inception one year ago, the DEC-20 laser print service has proven to be very popular; a month's run of 30,000-40,000 copies is not unusual. Since this laser printer is only rated for 10,000-30,000 copies per month, we are looking at laser printers having a higher capacity and greater durability. When we are able to bring such a unit on-line, the number of hours during which users may print jobs on a laser printer will most likely increase.

CYBER 850 Software Library Changes

by Judy Allio

LUCC has recently made three changes to the CYBER 850 software library: *PDE/PROTRAN* and the NAG FORTRAN Library have been added, and *TEMPLATE* has been upgraded.

PDE/PROTRAN

PDE/PROTRAN is a new member of the IMSL *PROTRAN* family of problem-solving systems; other members available at LUCC include *MATH/PROTRAN*, *STAT/PROTRAN*, and *LP/PROTRAN*. *PDE/PROTRAN* is a replacement for IMSL's *TWODEPEP* program, a finite element program for solving partial differential equations. *PDE/PROTRAN* has essentially all of the capabilities of *TWODEPEP* plus greater flexibility, as FORTRAN-77 statements may be mixed with *PDE/PROTRAN* statements. *PDE/PROTRAN* also contains additional features not present in *TWODEPEP*. These features are described in the document entitled *TWODEPEP to PDE/PROTRAN Conversion*, a copy of which can be found in the front of the binder containing the *PDE/PROTRAN User's Manual* (available at the central site users' area and on one-day reserve at the Fairchild-Martindale campus library). The conversion document also includes a table in which *TWODEPEP* statements are listed with their *PDE/PROTRAN* equivalents.

TWODEPEP will remain on the system as an unsupported product; IMSL no longer supports it.

The NOS control statement necessary to access and run *PDE/PROTRAN* is:

PROTRAN,lfn

where `lfn` is the name of the local file containing your *PDE/PROTRAN* program.

NAG FORTRAN Library

The NAG FORTRAN Library is a collection of mathematical and statistical subroutines which can be called from any FORTRAN-77 (FTN5) program. Before executing a program containing such calls, a `USE,NAGLIB` command must be issued in the job.

Documentation for the NAG FORTRAN Library consists of the following:

- *NAG Library Manual, Mark 11.* This manual fully describes the library; it consists of six volumes, all of which can be found at the central site users' area.
- *NAG FORTRAN Mini Manual, Mark 11.* This manual contains a summary of the purpose of each routine, along with recommendations on the choice and use of routines. This document is available at LUCC's Library, 185 Fairchild-Martindale.
- *CDC Implementation of the NAG FORTRAN Library, Mark 11 Implementation Document.* This document contains information specific to the CYBER implementation of the NAG Library, as installed under the NOS operating system. This write-up can be found in the front of the binder containing Volume 1 of the *Library Manual.*
- NAG-HELP. This is an on-line source of information; it compliments the *Library Manual.* Features of this on-line system are listed in the very front of the binder containing Volume 1 of the *Library Manual.* To access the help system, type `NAGHELP` at the NOS prompt.

TEMPLATE

TEMPLATE has been upgraded on the CYBER 850 to Version 5.5. This version contains numerous fixes; no new features were added. The new version does, however, require slightly more main memory.

Some changes were made to the *TEMPLATE Reference Manual*, as follows:

- Appendix G (Error Messages) was revised to include the addition of a small number of error messages; new error messages are listed with change bars.
- Appendix I was added; it contains example programs, the plots that they generate, plus explanatory text.

Copies of the *TEMPLATE Reference Manual* may be ordered through the University Bookstore. Note that the reference manual for Version 5.0 is still usable. The old *Introduction To TEMPLATE* and *TEMPLATE Example Set* manuals still apply; these two manuals are available at the University Bookstore. All three *TEMPLATE* manuals can be found at the central site users' area, the Christmas-Saucon site, and (on one-day reserve) at the Fairchild-Martindale campus library.

The NOS control statements to access and run *TEMPLATE* are described in LUCC's *Technical Bulletin #17 - Running Template on the CYBER*, available free of charge from User Services.

Micro Computing

Software Additions to the Sites

LUCC has recently made a number of additional programs available at various sites. What follows is a list of the total number of copies of these programs at each site. Note that the location "324 L.V. Bank Bldg." ("L.V." meaning Lehigh Valley) refers to a micro lab in what used to be the Union Bank Building.

Program	Location	Copies
GW-BASIC *interpreter*	Users' Area	5
	292 F-M	14
	257 Whitaker	14
	324 L.V. Bank Bldg.	5
	Grace Hall	4
	502 Packard	4
	208 Drown	15
	F-M Campus Library	4

PC-PLOT III	Users' Area	5
Tektronix 4010	257 Whitaker	5
emulator	Grace Hall	5
	502 Packard	5
	F-M Campus Library	5
VP-planner	Users' Area	5
spreadsheet/	292 F-M	12
database	257 Whitaker	14
	324 L.V. Bank Bldg.	9
	Grace Hall	10
	502 Packard	21
	208 Drown	15
	F-M Campus Library	10
	Linderman Library	2
	Media Center	2
MS-FORTRAN	Users' Area	1
compiler	292 F-M	12
	257 Whitaker	2
	Grace Hall	2
	502 Packard	2
	208 Drown	2
	F-M Campus Library	1
Lotus Release 2	Users' Area	2
spreadsheet/	292 F-M	12
database/graphics	257 Whitaker	1
	Grace Hall	1
	502 Packard	1
	208 Drown	12
	F-M Campus Library	1
	Linderman Library	1
TASMB	Users' Area	2
editor/	292 F-M	2
8086 assembler	257 Whitaker	2
	324 L.V. Bank Bldg.	15
	Grace Hall	2
	502 Packard	4
	F-M Campus Library	21
	Linderman Library	2
Turbo Prolog	Users' Area	9
logic programming	502 Packard	9
language		
TOPSI	Users' Area	9
AI programming	502 Packard	9
language		
True BASIC	All sites[1]	
interpreter		
WATFOR-77	All sites[1]	
compiler		

Documentation for the above software may be found at each of the sites which have the software, and on one-day reserve at the Fairchild-Martindale campus library. True BASIC, WATFOR-77 and Lotus 1-2-3 documentation may be purchased at the Microcomputer Store.

True BASIC Package Available

Lehigh University has a campus site license with Addison-Wesley Publishing Company to use the True BASIC Language System, and with True BASIC, Inc. to use the True BASIC library products. Under the terms of these licenses, Lehigh University faculty, staff, and students are free to make copies of the True BASIC package for on-campus use only.

Use of the True BASIC Language System is described in the *True BASIC User's Guide* and the *True BASIC Reference Manual*, both available at all of the public microcomputer sites listed below and on one-day reserve at the Fairchild-Martindale campus library. Copies may also be purchased at the Microcomputer Store.

True BASIC library products available for use with the True BASIC Language System at LUCC are: Developer's Toolkit, PC BASIC Converter, Asynchronous Communications Support, and the Runtime Package. Use of these library products is described in manuals which bear the name of the corresponding library product. Those four manuals can be found at the central site users' area and on one-day reserve at the Fairchild-Martindale campus library; they may also be purchased at the Microcomputer Store.

Disks containing the True BASIC package are available for copying at the following locations: the central site users' area, the micro labs at 292 Fairchild-Martindale, 257 Whitaker, and the Lehigh Valley Bank Building, the Grace and Drown Hall sites, 502 Packard, the Fairchild-Martindale and Linderman campus libraries, and

[1] You may make a copy of True BASIC or WATFOR-77 for use on-campus only, per Lehigh's license agreements.

the Media Center. Instructions for copying the disks are also available at those locations. Note that the set for *copying* is different from that for use at the sites.

WATFOR-77 Package Updated

by Monica Newman

A new version of WATFOR-77, Version 1.4, has replaced Version 1.1 at the public microcomputer sites. WATFOR-77 is a FORTRAN-77 compiler for which Lehigh University has a campus site license with WATCOM Products Inc. Under the terms of the license, Lehigh faculty, staff, and students are free to make copies of the compiler to be used on campus only.

The current WATFOR-77 package includes the following *new* features:

- WATCOM GKS (Graphical Kernel System), which is a library of WATFOR-77 callable graphics routines. Note that WATCOM GKS only works with this new version of WATFOR-77. WATCOM GKS supports a wide variety of graphics output devices, including the IBM CGA (color graphics adapter) and IBM EGA (enhanced graphics adapter) standards.
- The ability to generate *executable* files.
- Support for the linking of assembler-generated object files and library files, as well as the linking of IBM Professional FORTRAN compatible object code. Note that WATFOR-77 does **not** support the *generation* of object files. It is assumed that any object files to be linked are created via an assembler such as IBM's Macro Assembler "MASM" or via IBM Professional FORTRAN.
- New WEDIT commands TABSET and BELL. TABSET can be used to set up to 15 tab stops; as an example, the command "TABSET 7 11" sets tab stops at columns 7 and 11. BELL causes the microcomputer's bell to sound when the cursor moves past the specified column; for example, the command "BELL 72" will cause the bell to sound when the cursor moves from column 72 to 73. Setting BELL to 72 is particularly useful for FORTRAN programming.

The LUCC write-up entitled *Introduction to WATFOR-77 (Version 1.4)* includes an overview of the generation of executable files and the linking of object and library files. That write-up also includes a brief introduction to WEDIT.

Disks containing the WATFOR-77 package are available for copying at the following locations: the central site users' area, the micro labs at 292 Fairchild-Martindale, 257 Whitaker and the Lehigh Valley Bank Building, the Grace and Drown Hall sites, 502 Packard, the Fairchild-Martindale and Linderman campus libraries, and the Media Center. Instructions for copying the disks are also available at those locations. ***Note that there are three different sets of disks for copying; be sure you copy the set for the type of system on which you will be working.*** Dual floppy system users should copy the appropriate *two* disk set, depending on whether or not the system is equipped with an 8087 math co-processor. One of the two disks contains the compiler and WEDIT, the other contains GKS. Fixed disk system owners should copy the *three* disk set, which has both versions of the compiler on one disk, WEDIT on another disk, and GKS on the other disk. The first of these three disks also contains a batch file for copying the contents of the floppies to the fixed disk; the directories into which they are copied are described in the copying instructions.

The LUCC write-up *Introduction to WATFOR-77 (Version 1.4)* is available at the locations listed above. Formal documentation for the WATFOR-77 package consists of the following, available for reference at the sites listed above (also on one-day reserve at the Fairchild-Martindale campus library) and for purchase at the Microcomputer Store:

- *WATFOR-77 User's Guide IBM PC with DOS*
- *WATFOR-77 Language Reference Manual*
- *WATCOM Editor User's Guide*
- *Supplement to WATCOM Editor User's Guide*
- *WATCOM GKS Graphics Tutorial and Reference Manual*

Use of the WATFOR-77 user's guide is recommended. Note that the user's guide has been revised for this new release of WATFOR-77. The new user's guide is organized differently than that for our prior release of WATFOR-77 (V1.1), and contains a chapter describing the use of subprogram libraries.

Refer to the WEDIT user's guide for information beyond that available through WEDIT's help facility. Note that the editor user's guide has not changed for this new release of the WATFOR-77 package; new WEDIT features are described in the *Supplement* mentioned above.

WATFOR-77 is licensed to operate for a period of one year on an annually renewable basis, after which time WATCOM Products Inc. will supply Lehigh with new WATFOR-77 master disks containing the new expiration date and any enhancements which may have been made. Note that the expiration date on the current disks is August 31, 1987. Before that date, copies of new WATFOR-77 master disks will be placed at the public microcomputer sites; these copies will replace the current copies of WATFOR-77 at the sites.

Local Area Networks — Primer

PART II

by George E. Oberlander

In the first article of this series, I gave a brief overview of the different parts of a typical Local Area Network (LAN) as well as an overview of common LAN capabilities. In this article, I want to focus on the physical structure of the LAN, to explain the access methods used by workstations to send information, and to briefly describe some of the issues and results in the effort to standardize LAN communications.

LANs may be divided into two major groups based on the transmission technique employed. The two principal transmission techniques are broadband and baseband. In order to understand the difference between broadband and baseband transmission, we must understand the concept of *bandwidth*. When any signal is transmitted, a range of frequencies is used. This range is the bandwidth. For example, telephone voice transmission requires a range of 3000-4000 cycles per second (3-4 kHz) for adequate intelligibility. A TV channel requires a range (bandwidth) of 6 MHz in the United States. In baseband transmission, the entire bandwidth of the medium is utilized by one signal; usually the signal is a straight digital pulse, without mixing with a higher frequency signal (modulation). This means that only a single channel of communication is available at any given time. By contrast, broadband transmission divides the medium into multiple channels, each with its own bandwidth. A coaxial cable, for instance, can accommodate a bandwidth of 300 MHz, which will theoretically allow, for example, about 100,000 simultaneous voice transmissions. Broadband's multi-channel capacity allows voice, data, and image to be transmitted on one cabling system. As the office automation technology advances, there will be increased demand for integration of voice, data and image, giving broadband LANs an important advantage over their baseband cousins. Some baseband LANs, however, have the advantage of a lower cost, easier to install, cabling system like twisted pair. Perhaps the majority of baseband LANs, though, elect to use coaxial cable since it supports a higher data transfer rate and is far less susceptible to interference than twisted pair. Interfacing baseband LANs is less expensive than broadband interfacing since there is no modulation required with the former. This eliminates the need for modems on the LAN.

Today, there are more "short-haul" (i.e., distance less than 3 km) baseband LANs than short-haul broadband LANs. Important short-haul baseband offerings include 3COM's Ethernet LAN and IBM's Token Ring LAN. LUCC is looking at these two LANs closely, because the InteCom digital system may allow connection with 3COM's Ethernet, and the IBM offering is certain to become an industry standard.

The pattern by which a LAN's workstations are connected is called the *topology*. Several different topologies are in common use; the four most popular are the star, bus, tree and ring.

The star network topology has its devices connected directly to a central server, without any intermediaries. Each device has its own connector cable to the server, and no device is directly connected to another device except through the server. Hence, the topology resembles a star with rays. The star topology is one of the oldest connection schemes, and one of the least reliable.

The bus topology employs a central cable (the "bus"), which runs the length of the network like a backbone, to which the network devices are attached. Bus topologies typically employ coaxial cable, with some LANs boasting cable lengths of up to 5 km.

When one bus is connected to another (resembling an organization chart or a diagram where main paths branch into sub-paths), the

result is a tree topology. In this arrangement, a hierarchy comes into being, with member devices at the same level unable to directly communicate with one another.

In a pure ring topology, each member is connected only to its two immediate neighbors as when you draw a polygon. The pure ring topology is not very reliable since a failure anywhere along the ring will cause the entire ring to fail. However, this may be modified with the addition of alternate pathways, such as a pair of concentric rings.

Closely related to the LAN topology is the (signal) access method used. As with topologies, there are four common access modes: slot, token passing, contention and ordered access bus.

The slot approach is founded on "time division multiplexing" — combining signals on one common path based solely on a time-based window to transmit. A fixed number of time slots continuously circulates around the network (which uses the ring topology). There is a full/empty indicator near the beginning of each signal block which is set to full when the sender wishes to communicate a message.

The token passing approach, first made widely known by Datapoint's *ARC* (Attached Resource Computer) network, has now been adopted by IBM in its effort to achieve communications across its product line. In this access method, a certain pattern of bits (the "token") is circulated from workstation to workstation, around the LAN. Only when a workstation has the token can it transmit. After it has completed transmission, the workstation passes the token to the next workstation in line.

Quite possibly the most widely used access method is the contention scheme known as "carrier-sensing multiple access with collision detection" or CSMA/CD. It is employed in a wide variety of LANs, including the ever present Ethernet protocol. In CSMA/CD, a station wishing to transmit listens to the network bus to see if it is clear to transmit. If some other transmission is in progress, it waits until this activity has been completed. Collisions (simultaneous transmissions) cannot be completely prevented, since it takes a certain amount of time to generate a signal along the bus and during this time another station can also initiate transmission. If such a collision is detected, both stations retransmit at randomly determined intervals.

The access method has a great influence on the performance of the LAN. Access method performance varies greatly under differing kinds of network traffic patterns. For example, CSMA networks generally perform better with sporadic, "bursty" traffic patterns, where a few stations transmit large bundles of data or transmit very often. This type of traffic pattern tends to minimize collisions, reducing the amount of time lost to retransmissions. Access methods where the privilege to transmit can be controlled (the "deterministic" methods, like the token passing and the slot approach), do better under uniform, heavy traffic than do CSMA networks. Here, the greatest performance factor is the number of network workstations, since the right to transmit must have passed through every workstation in turn before any given workstation can transmit.

As LANs developed, it became critically important to establish a variety of standards pertaining to physical connections, access methods, information encoding and decoding, and network topologies. Many incompatibilities come to light when equipment from multiple vendors is interconnected, which is what typically happens in a LAN environment. Therefore, a number of national and international agencies have become involved in the effort to create the standardization necessary for reliable interconnection of equipment and systems. For the standardization of LAN technology, probably the most important effort lies with Project 802 of the IEEE (the Institute of Electrical and Electronics Engineers). This group began work in February, 1980, with the intent of providing standardization for digital information interchange. Three subcommittees focused on the topics of media, access control and higher-level interface. Project 802 created a reference model for digital communication, which is composed of 7 layers. These layers are, in turn, organized into the functional groups: physical layer, data link control, networking and transport. The International Standards Organization (ISO) also proposed a 7 layer standard for LAN architecture called the OSI (open systems integration) model. The OSI model differs from the IEEE model in both the lower layers (where the former uses fewer subdivisions) and in the higher layers (where it has more subdivisions). The 7 layers of the OSI model are: physical, data link, network, transport, session, presentation and application. Like the IEEE model, the protocol standardization effort began at the lowest levels and has not yet reached the final levels. For simplicity, we will look briefly at the IEEE model, elaborating on what constitutes each level.

The physical level is concerned with the cabling as well as with the device for connecting to the network, the media access unit (MAU). Vendors variously describe this device as a "network interface unit" or as a "network adapter card." The data link control level involves the control of traffic on the media (e.g., when to permit data transmissions by workstations) and the interface between the physical and logical functions of the network. Matters of synchronization, error detection and recovery procedures are all found at this level. It is here that the token ring, CSMA/CD, binary synchronous (BSC), and synchronous data link control (SDLC) protocols all lie. The networking level focuses on establishing a path through the network and the routing of information. Here, the IEEE uses the "datagram" model and the ISO uses the "virtual circuit" model. The datagram model places the responsibility for routing packets on the destination workstation. The virtual circuit places this responsibility on the network; packets must be arranged at network switching locations prior to being sent on to the destination workstation. Finally, the transport level focuses on the interface between the LAN and the application program (e.g., how file locks are to be generated by the application program's "write" commands) as well as insuring the correct delivery of information even if failures have occurred at lower level protocols. The recently developed Department of Defense's transmission control protocol (TCP) is an example of a transport protocol. The transport level has not been studied by either IEEE or OSI.

Project 802 defines three types of LAN technologies (which are really a mixture of two topologies and two access methods): contention using CSMA/CD, a token bus, and a token ring. The contention scheme became formalized in mid 1983 as IEEE standard 802.3, an "Ethernet" standard. You will see "802.3" often appear in Ethernet discussions. Basically, it calls for the following characteristics:

- Transmission frequency: 10 Mbps
- Transmission type: baseband
- Topology: bus
- Access method: CSMA/CD
- Type of transmission: packet switching
- Packet length: 64-1518 bytes
- Max. distance between stations: 2.5 km
- Max. length of a segment: 500 m
- Max. no. of stations: 1024
- Max no. of stations per segment: 100

These standards obviously created much higher levels of compatibility between vendor offerings that claimed adherence to the Ethernet "standard." And, yet, complete compatibility has not been achieved. When Ethernet was jointly developed in the mid-1970's by Digital Equipment, Intel, and Xerox (the so-called "DIX" group), there were significant differences from the more recent IEEE 802.3 standard which required the DIX group to revise its design. Now, one of the major remaining differences lies in the higher-level protocols between the network and transport-level protocols. Currently, the XNS (Xerox Network System) and the TCP/IP protocol (developed by the Department of Defense) are competing against each other, primarily because standardization has not yet reached this level. Care must be continually exercised, since vendors will still advertise systems as "Ethernet compatible" even though such systems might be broadband rather than baseband, or use media other than coaxial cable.

IEEE 802.5 describes the standards for the token ring LAN. These standards form the basis for IBM's token ring network, introduced in October, 1985. IBM's token ring LAN, which is its second LAN entry, is important for two reasons. First, the powerful influence of this $30+ billion company gives any product it introduces a lot of clout. The LAN market to date has not been dominated by any single offering; it is open to a standard-setting product which will encourage compatibility the same way that IBM's PC did. The second reason for the token ring's importance is that IBM has given it a central role in bridging the serious incompatibilities in its product line. Connectivity with its mainframe SNA architecture and the smaller System 3x and 43xx is being added.

The transmission mode for the token ring LAN is baseband at a 4 Mbps rate. The IBM version upholds this standard for most cabling except lower quality, unshielded twisted pair — the so-called type 3 media. The IBM version implements a star-shaped ring topology, with groups of up to 8 workstations connected to a "multistation access unit." This device contains relays which can switch a workstation out of the LAN if it begins to malfunction.

Network Operation

Mainframe Connections Using InteCom

by Monica Newman

This article describes how to establish a connection with the Cyber 850 and DEC-20 using the InteCom integrated voice/data communications system.

From on campus, a connection with a computer is possible only if your terminal or microcomputer is connected to an ADI-100 or an ADI-101. (The ITE 4 phone, by itself, does not have data capabilities.) All LUCC-maintained terminals and microcomputers are connected to ADI's (but the microcomputers also need to be running a terminal emulation program — such as Kermit — in order for them to behave as terminals.) Note that modems are no longer usable on campus. *Never attach a modem to the InteCom system; you will either damage the InteCom port or damage the modem.*

InteCom provides two ways to "dial" a computer's access number from on campus: by pressing the appropriate numbers on the ITE phone, or by typing them in at your keyboard using an InteCom facility called MKO (Machine Keyboard Origination). Since the public site terminals and microcomputers do not have phones connected to them, on those devices dialing must occur using MKO.

Note that information on the use of InteCom to dial off-campus mainframes or other on-campus mainframes or microcomputers can be obtained by attending LUCC's seminar entitled "Using the Campus Voice/Data System for Computer Communications", scheduled for September 17th from 4:10 PM to 5:30 PM in 207 Whitaker. If you are unable to attend this seminar, you may want to obtain its detailed outline from User Services.

Connecting from Off campus

The only changes for off-campus access of these mainframes are the telephone numbers. For 300 or 1200 baud communications with the CYBER 850, dial 974-6812. For 300 or 1200 baud communications with the DEC-20, dial 974-6200. (As can be seen, there is now a single phone number for 300/1200 baud communications with each machine.)

Connecting from a Public Device

Each LUCC-maintained terminal and microcomputer is able to connect (at 9600 baud) to either the CYBER 850 or the DEC-20 — and to other mainframes (having the same communications parameters) as those computers become connected to InteCom. Connection to a particular system occurs after the appropriate number is "dialed" using MKO.

At each terminal are instructions as to how to access MKO and dial the Cyber 850 or DEC-20. (*Keyboard Dialing* in the next section also describes the use of MKO.) Several seconds after MKO displays the message "DATA CALL INITIATED", press the RETURN key; you should then see the system's banner. Log in as you normally would.

Those using one of the public microcomputers should boot the microcomputer with a "NetDial" diskette, available at each site. These diskettes start the system and run NetDial, a menu-driven program written by LUCC. In response to the option you select, NetDial "dials" the appropriate system using MKO and then loads MS-Kermit (Version 2.29) for you. (MS-Kermit is a terminal emulation program with file transfer capabilities.) After MS-Kermit is loaded, the microcomputer will beep — at which point you should press the RETURN key; you should then see the mainframe's banner. Further help on the use of NetDial is available from within NetDial. NetDial includes an option to access the CYBER 850, and three options to access the DEC-20, depending on whether you intend to use EMACS, MUSE or NCPCalc during the terminal session. (With each DEC-20 option, the function and/or numeric keypad keys are appropriately defined for the particular program. If you do not intend to use any of those programs with special keys, you can choose any DEC-20 option.) After logging in to the DEC-20, issue a `TERM VT52` command to declare your terminal type. After logging in to the CYBER 850, issue a `SCREEN,PCKERM` command if you intend to use any of the full screen programs, such as FSE, in full screen mode. (Note that you can use FSE the same way as if you had declared `SCREEN,PCCONN` under CONNECT.)

Connecting from an On-campus Office or Dorm

As stated above, in order to access a computer from on campus, your terminal or microcomputer must be attached to either an ADI-100 or an ADI-101. There is a 25-pin connector on the back of the ADI to receive a serial cable from your terminal or microcomputer. Again, modems are not usable on campus.

If you will be using a microcomputer to access one of LUCC's mainframes, you may want to acquire a copy of NetDial — a menu-driven program written by LUCC — and Version 2.29 of MS-Kermit. NetDial uses MKO to establish a connection with the system selected, and then loads MS-Kermit for you; NetDial is described in a bit more detail in the previous section. To acquire a copy of NetDial (V2.0) and MS-Kermit (V2.29), bring a blank disk to a public microcomputer site, obtain a NetDial/Kermit master disk (as well as a MS-DOS Disk I, which has the DISKCOPY command on it) at the software desk, and copy the contents of the NetDial/Kermit disk onto your blank disk using one of the dual floppy systems at that site. Instructions for copying are available at the software desk. (Those who have a copy of NetDial which either displays no version number or a version number less than 2.0 at the main menu should read the following article "NetDial Updated."

Below are the steps to access the Cyber 850 or DEC-20 from an on-campus office or dorm, using either a terminal or a microcomputer not running NetDial.

1. If you are using a terminal, set it to 9600 baud, 8 data bits, 1 start bit, 1 stop bit and no parity.

   If you are using a microcomputer to access either system, first run your terminal emulation program. Set the baud rate to 9600. If using Kermit, you would type **SET BAUD 9600** and press the RETURN key to Kermit's prompt. (If you obtained a copy of MS-Kermit V2.29 from the Computing Center, 9600 baud is automatically set when Kermit is started. You can determine the baud rate at which Kermit is currently set by typing **STATUS** and pressing the RETURN key to Kermit's prompt.)

2. Keyboard or phone dial, as follows:

Keyboard dialing:

- You must first toggle a terminal signal called "DTR" (Data Terminal Ready) in order to access MKO; MKO will then prompt you with the choices:

  ```
  DIRECTORY(D)
  NETWORK(N)
  OUTSIDE(O)
  OR TERMINAL TYPE CHANGE(T)
  ```

  On a TeleVideo, you can toggle DTR by turning the terminal off and then on again. On a Visual 102, this can be done by pressing the SETUP key, then the F1 key, then (after about 5 seconds) the F1 key again, and finally the SETUP key again. For instructions for other terminal types, call the HOT LINE at ext. 84141.

  DTR is toggled when a microcomputer is turned on. (If running MS-Kermit V2.29, DTR can also be toggled by typing **HANGUP** and pressing the RETURN key to Kermit's prompt.) If DTR has been toggled, Kermit users should see the MKO prompt after typing **C** — for **CONNECT** — and then pressing the RETURN key to Kermit's prompt.

  If MKO should issue a timeout message, DTR will have to be retoggled. (To retoggle DTR, microcomputer users using MS-Kermit V2.29 can issue its HANGUP command. However, to get Kermit's prompt again, they must first press the Ctrl and] keys simultaneously, release them, and then type a "C".)
- To MKO's prompt, type a **D** (for DIRECTORY) and press the RETURN key; you should then see the MKO prompt "ENTER DESTINATION NUMBER >".
- You may then enter the appropriate five-digit extension for the mainframe and press the RETURN key — or you may enter a mnemonic for the mainframe and press the RETURN key. The 9600 baud

extension for the CYBER 850 is **46800**; the extension for the DEC-20 is **46200**. The mnemonic for the CYBER 850 is **CYB850**, that for the DEC-20 is **DEC20**. You should see the message "DATA CALL INITIATED" after entering the number or mnemonic.

- After several seconds, press the RETURN key; the system banner should appear. Log in as you normally do.

Phone dialing:

- Remove the handset from the phone cradle and dial the appropriate extension for the desired mainframe — 46800 for the CYBER 850 or 46200 for the DEC-20.
- When a steady tone is heard, press **<ACCESS>** <#> <#> on your ITE 4 phone to establish the data connection — and then place the handset back into the phone cradle.
- If you are using a microcomputer, you need to complete the connection. If using Kermit, type a `C` — for `CONNECT` — and press the RETURN key to Kermit's prompt.
- Press the RETURN key; you should see the system banner. Log in as you normally do.

3. When you want to disconnect from the mainframe, logout, remove the handset from the phone cradle, and press <#> <#> to clear your data line. (Microcomputer users running MS-Kermit V2.29 can clear the data line by typing `HANGUP` to Kermit's prompt. To get Kermit's prompt, they must first press the Ctrl and] keys simultaneously, release them, and then type a "C".)

NetDial Updated

by Kenneth R. van Wyk

NetDial is micro-based, menu-driven program written by LUCC for use with the InteCom system. In response to the option selected at its main menu, NetDial dials the appropriate computer and then loads Kermit.

NetDial has recently been updated to Version 2.0. Those of you who have a copy of NetDial which either displays no version number or a version number less than 2.0 at its main menu can update to V2.0 in one of two ways. The first way involves downloading the necessary files from the DEC-20 as described below. (You need not have your own DEC-20 account to do this.) The second way involves producing a copy of the NetDial/Kermit master disk (available at all public microcomputer sites), and then using the copy to update (as per the written instructions also available at the sites).

Those interested in acquiring a copy of NetDial (and Kermit V2.29) for the first time should also copy that NetDial/Kermit master disk. The written instructions which accompany the master disk also describe how to install the software on a hard or floppy disk for the first time.

The updated version of NetDial includes the ability to dial off-campus (computer) numbers. The updated version of NetDial also includes a "K" option at the main menu, which runs Kermit directly and enables one to then dial manually (using keyboard or phone dialing). In addition to these changes, NetDial no longer uses multiple sub-directories for different function key definitions; this saves on disk space (as well as confusion). Another change with NetDial is that there are no longer separate floppy-disk-based and hard-disk-based versions.

Described below is the procedure for downloading the files necessary to update NetDial, and for then updating NetDial.

1. If you are using a hard disk system, first go to the directory C:\INTECOM by issuing the following MS-DOS commands:

```
C:
CD C:\INTECOM
```

2. Dial the DEC-20 using your current version of NetDial. (Any of the three DEC-20 dialing options will suffice.)

3. Once you see the DEC-20 system banner, log in as follows:

```
LOGIN --LUMUG MICRO
```

(*MICRO* is the password - it will NOT echo.)

4. You will then be prompted for a terminal type. Respond by typing

```
15
```

for type VT52.

5. At the BB> prompt, type:

   ```
   TRANSFER
   ```

   to access the file-transfer facility (Kermit-20).

6. At the BBKERM> prompt, type:

   ```
   SERVER
   ```

   to enter Kermit's Server mode.

7. "Escape" to Kermit-MS by issuing a:

   ```
   Ctrl-] C
   ```

   That is, press the Ctrl and] keys simultaneously, release them, and then press the C key.

8. At the Kermit-MS> prompt, type the following (waiting until a previously requested file transfer is complete before issuing the next GET command):

   ```
   GET NET20.COM
   GET *.INI
   GET UPDATE.BAT
   ```

9. Exit Server mode by typing the following at the Kermit-MS> prompt:

   ```
   FINISH
   ```

10. Reconnect to the DEC-20 by typing the following at the Kermit-MS> prompt:

    ```
    CONNECT
    ```

11. Log out of <--LUMUG> by typing:

    ```
    QUIT
    ```

12. Escape back to Kermit-MS (with a Ctrl-] C) and then type the following at the Kermit-MS> prompt:

    ```
    QUIT
    ```

13. Exit NetDial, by selecting option "X".

14. Update your version of NetDial by typing the following at the MS-DOS prompt:

    ```
    UPDATE
    ```

Your NetDial will then be updated. As stated above, the updated version of NetDial has the ability to dial off campus; thus, the file PHONE.BK which is used by the user-supplied list option may include off-campus numbers, and an off-campus number may be specified after choosing the manual dial option. Note that you **must not** precede off-campus numbers with a "9", and that the phone line which you are using must be physically capable of dialing off campus.

It is anticipated that NetDial will be updated from time to time, to add new features and/or correct bugs. To determine what the most recent version of NetDial is, log in to the DEC-20 and issue the following command:

```
TYPE <MICRO>NETDIAL.DOC
```

if logging in to your own account, or:

```
TYPE NETDIAL.DOC
```

after selecting the Transfer option if logging in to <--LUMUG>.

General Interest

Public Computing Locations

by Carol Rauch

Over the summer, numerous changes were made to update the facilities. In the list below, most locations are categorized as being either a public site, public facility or public micro lab; each of those is available to all faculty, staff and students.

Note that the micro labs can be reserved for ongoing course instruction or for a single presentation, and so may be unavailable at certain times. A list of times at which a given micro lab is reserved during the week can be found at that lab. Reservations for micro labs must be made at least one week in advance, with User Services at ext. 83990.

Place	Type	Equipment
Central Site Users' Area	Public Site	17 Zenith micros (7 with EGA monitors and boards) 1 IBM PC 6 Seiko color graphics display terminals 18 display terminals (2 graphics)

		2 letter quality printing terminals 1 Seiko color graphics printer 1 HP LaserJet printer 1 daisy wheel printer 2 dot matrix printers
Special Equipment Room (adjacent to Central Site Consultant's Area)	Public Site	6 Zenith micros 1 IBM PC 1 Apple Macintosh Plus 1 display terminal 1 letter quality printing terminal 1 daisy wheel printer 2 dot matrix printers (1 Apple Imagewriter) 2 HP plotters 1 digitizer pad 1 Polaroid Palette image recorder 1 80 column card reader
292 Fairchild-Martindale	Public Micro Lab	15 Zenith micros 1 HP LaserJet printer 2 dot matrix printers Aquastar IIIC Projector System
257 Whitaker	Public Micro Lab	14 Zenith micros 1 HP LaserJet printer 1 dot matrix printer Aquastar IIIC Projector System
324 Lehigh Valley Bank Bldg.	Public Micro Lab	16 Zenith micros 1 HP LaserJet printer 1 dot matrix printer Aquastar IIIC Projector System
Linderman Library (Rooms 2, 104, 108, 202)	Public Facility	15 Zenith micros 1 HP LaserJet printer
F-M Campus Library	Public Facility	46 Zenith micros 1 HP LaserJet printer
F-M Media Center	Public Facility	9 Zenith micros 1 HP LaserJet printer
Grace Hall	Public Site	27 Zenith micros 23 display terminals (1 graphics) 1 remote spooled 600 line-per-minute Cyber printer 1 HP LaserJet printer 2 dot matrix printers
502 Packard	Public Site	21 Zenith micros 1 HP LaserJet printer 2 dot matrix printers
208 Drown	Public Site	17 Zenith micros 1 HP LaserJet printer

		2 dot matrix printers
439 Whitaker	Public Site	3 Zenith micros 2 display terminals (1 graphics) 1 printing terminal 1 dot matrix printer
Christmas-Saucon (Rooms B8, B10, B9/11)	Public Site	23 display terminals 3 printing terminals
Fritz Annex Room A3	Public Site	4 display terminals 1 printing terminal
207 Whitaker	Auditorium	1 Zenith micro 4 monitors Reservations through Registrar

Newsbriefs

EDUNET applications are being accepted again. Lehigh University is a member of EDUNET, a national computing network for higher education and research. Through EDUNET, computing facilities of such institutions as Cornell, MIT, Dartmouth and Carnegie-Mellon can be accessed. A complete list of member institutions and their computers accessible via EDUNET can be obtained from Judy Allio in the LUCC Library, 185 Fairchild-Martindale, ext. 83993. Judy also has information about what special software is available on EDUNET member computers. Limited funds are available to faculty for using EDUNET for instructional purposes or University-funded research. Those interested should contact Judy Allio. Note that the deadline for EDUNET requests is Sept. 22. The next scheduled review will occur in February, 1987.

Staff Changes

Congratulations to Florence Hughes of User Services, recently promoted to Accounts Coordinator. Replacing Florence as Data Processing Assistant is Doris Oravec. Doris comes to LUCC from the Bursar's Office, where she had worked for 6 years.

Joining the Programming Group are Mark Miller and Dan Schwartz. Mark recently received his Master's in Computer Science from Lehigh and will be serving as our Network Analyst. Dan, also a recent Lehigh graduate (B.S. in Computer Engineering), is our new Microcomputer Programmer. Both Dan and Mark worked for LUCC part-time while students.

There's a new Secretarial Assistant in the office of the Director of LUCC. That's Pam Steigerwalt, who had been an Executive Secretary with Eagle Shirtmakers for 2 1/2 years.

The newest addition to the Microcomputer Store staff is Larry Simek. As a Maintenance Technician, Larry will be responsible for equipment setups, delivery, and board-level repairs. Larry comes to LUCC from Central Stores, where he had been a Clerk during the past year.

Computing at Lehigh--Contribution Information

Computing at Lehigh encourages contributions for articles, *Consultant's Corner*, *Feedback* and *Tips and Traps*.

We prefer that contributions be submitted electronically via DEC-20 mail to the directory <--LUGEO>, be provided on an MS-DOS formatted 5.25 inch floppy disk, or be provided on a 3.5 inch micro floppy disk in Lisa (LisaWrite) or Macintosh (MacWrite) format. Contributions sent via DEC-20 mail must be in ASCII (plain text) and may have embedded Scribe commands. Acceptable MS-DOS document formats are:

- ASCII (not word-processed)
- Freestyle
- PeachText
- DisplayWrite2
- MS-Word
- WordMARC
- EasyWriter
- PC-Write
- WordStar

Printed copy will be accepted, but please try one of the above methods (especially for articles and other long contributions). All mailed contributions (whether on diskette or printed) should be sent to the following address:

Editor, Computing at Lehigh
196 Fairchild-Martindale #8b
Computing Center
Lehigh University
Bethlehem, PA 18015

Articles by users are included at the Computing Center's discretion. The Computing Center reserves the right to edit all contributions.

Article submissions should be completed by the 15th of even-numbered months. Be sure to include your name, mailing address, and phone number.

Computing at Lehigh Mailing List

Check one:

- ☐ **ADD** my name to the mailing list.
- ☐ **CHANGE** my address on the mailing list. (List both old and new addresses and be sure to include the Zip Codes.)
- ☐ **DELETE** my name from the mailing list. (Please include the mailing label or complete address.)

Campus

Name: _____

Dept.: _____

Room & Bldg.: _____

Off-Campus

Name: _____

Address: _____

_____

_____ Zip Code: _____

Old Mailing Address (if changing or deleting):

Return to:
Computing at Lehigh Mailing List
196 Fairchild-Martindale #8b
Computing Center
Lehigh University
Bethlehem, PA 18015